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SOLAR/2021-79/05

Monthly Performance Report

IRVINE SCHOOL

MAY 1979

U.S. Department of Energy

National Solar Heating and Cooling Demonstration Program

National Solar Data Program

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MONTHLY PERFORMANCE REPORT
IRVINE SCHOOL
MAY 1979

I. SYSTEM DESCRIPTION

The El Camino Real Elementary School, referred to hereafter as Irvine School, is located in Central Orange County, California. The school is approximately ten miles from the Pacific Ocean, and was built in 1971. The building contains 41,109 square feet of floor area, and is normally occupied five days a week by 850 children and 60 adults. Building occupancy is uniform throughout the year since the school operates on a trimester plan. The solar energy system was added to the existing building, and was designed to supply 50 percent of the annual building heating and cooling demand.

The solar energy installation includes 4,950 square feet of evacuated tubular glass collectors, a heat rejector, and a heat exchanger from the collector loop to the load loop. The collector array faces south at an angle of 25 degrees from the horizontal. Water is used as the medium for delivering solar energy from the collector array to the heat exchanger for transfer to the load subsystems. Existing load loop components were unaltered except for controls. These load loop components include a 4-million Btu per hour boiler, two 100-ton absorption chillers, 41 heating coils, and seven air handlers. Since heating demands are low due to the moderate climate and most of the load demand occurs during the day, no solar energy storage is provided. The collected solar energy is transferred directly from the collector loop to the load loop via the heat exchanger. If collected energy exceeds the load loop demand, excess energy is rejected via the heat rejector. The heat rejector is a water-to-air heat exchanger mounted on the roof and situated in the collector loop between the collector outlet and the load loop heat exchanger inlet. If the solar energy does not meet the full energy demand from the loads, the boiler is activated to make up the shortage before the hot water

reaches the loads. The hot water is routed to the chillers or heating coils, or both, depending on the building demand. The hot water then returns to the heat exchanger to complete the cycle.

The system, shown schematically in Figure 1, has five modes of solar operation.

Mode 1 - Collector Protection: This mode occurs when the lower flow capacity (15 GPM) auxiliary collector pumps are turned on by a clock timer. This is normally before collection begins and is required to precondition the collectors for main pump flow and ambient temperature conditions. This mode is reentered daily at the completion of mode 2 operation, and is subsequently terminated by the clock timer. Since no other freeze protection subsystem is provided, this mode is also entered when the outside ambient temperature is less than 38°F. The clock controller is overridden for freeze protection entry when this control temperature has been reached.

Mode 2 - Solar Energy Collection: This mode occurs when the main collector pump (125 GPM) is on. Mode entry requires a differential temperature of 15°F between the collector outlet and the load side inlet to the heat exchanger. When the differential temperature again drops below 15°F (adjustable), mode 1 is reentered.

Mode 3 - Collector-to-Space Heating/Cooling: In this mode, heating and cooling loads may be active at the same time. This mode is enabled at all times, and receives energy from the solar energy system when available. If solar energy is not available, or is insufficient to satisfy the full demand, the auxiliary boiler is activated to supply the remaining demand. At night, this mode is normally disabled by the clock timer.

Mode 4 - Solar Heat Rejection: This mode occurs when excess solar energy is diverted from the collector loop and rejected to the environment

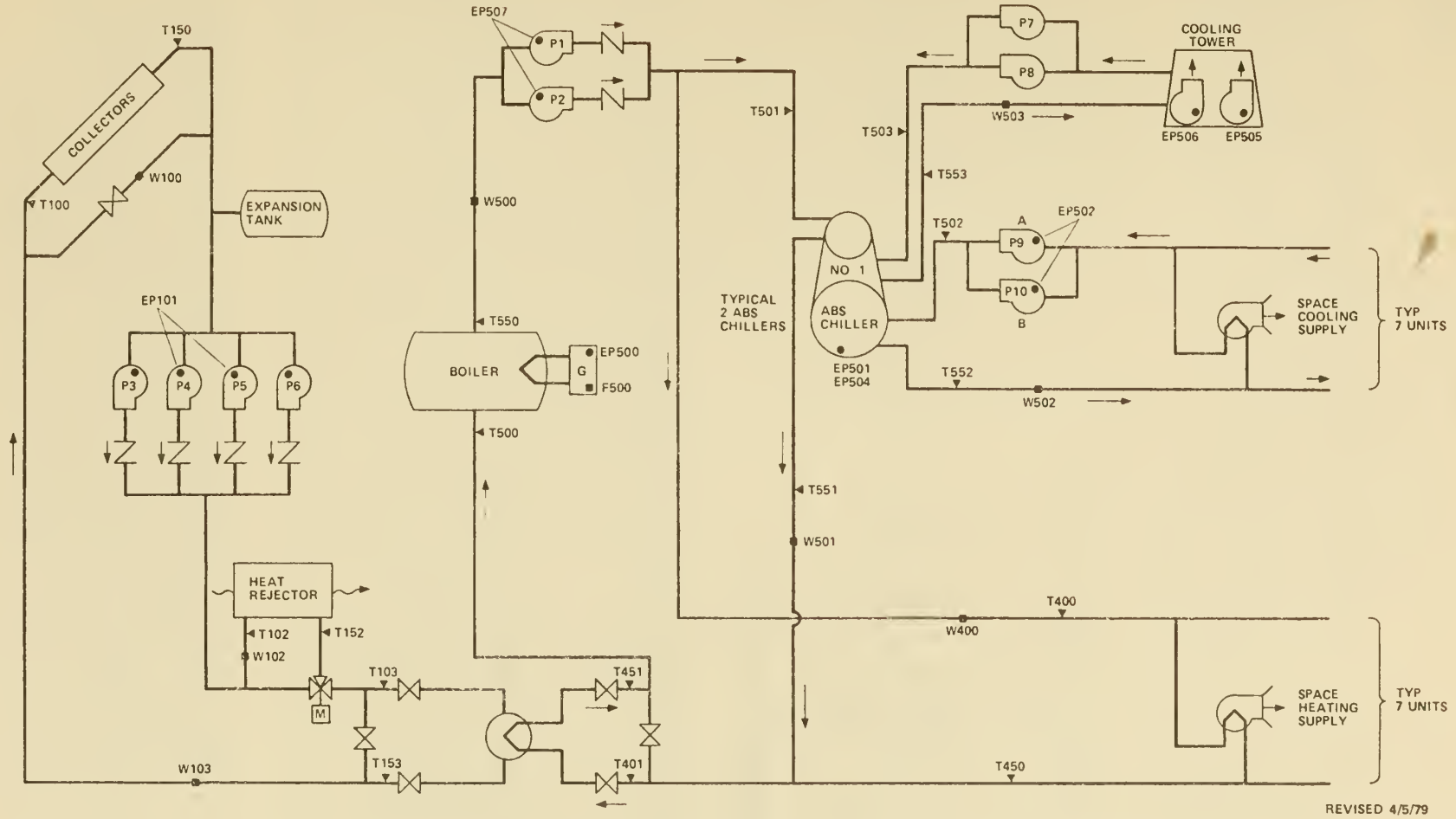

Figure 1. IRVINE SCHOOL SOLAR ENERGY SYSTEM SCHEMATIC

through a liquid-to-air heat exchanger on the roof. This mode is entered if the temperature at the collector loop outlet from the heat exchanger exceeds a variable set point (approximately 215°F). Upon exceeding this set point temperature, a three-way valve is switched to initiate collector loop flow through the heat rejector, and the heat rejector fan is turned on to increase the air flow across its coils. When the heat exchanger outlet temperature drops below another variable set point (approximately 200°F), the three-way valve is reversed, the heat rejector fan is turned off, and this mode is terminated.

Mode 5 - Collector Backup Protection: This mode is entered when the collector outlet temperature exceeds a set point (approximately 220°F). Control design assumes the collector pumps are not operating if this temperature is exceeded. In this mode, normally open solenoid valves allow city supply water to enter the collectors and drain out at the collector outlet. This mode protects against collector thermal shock damage if a power outage occurs.

II. PERFORMANCE EVALUATION

The system performance evaluations discussed in this section are based primarily on the analysis of the data presented in the attached computer-generated monthly report. This attached report consists of daily site thermal and energy values for each subsystem, plus environmental data. The performance factors discussed in this report are based upon the definitions contained in NBSIR 76-1137, Thermal Data Requirements and Performance Evaluation Procedures for the National Solar Heating and Cooling Demonstration Program.

A. Introduction

The solar energy system at Irvine School operated continuously during May, and satisfied 17 percent of the combined space heating and cooling energy requirements. By design, the system performed heating and cooling simultaneously for different areas of the building. The space cooling requirements were 79 percent of the total system load.

B. Weather

Due to the year-round mild outside ambient temperatures in the Irvine School area, only a relatively small heating load, or cooling load, is expected. In comparison to an expected outside ambient temperature of 61°F, the actual outside ambient temperature averaged 66°F during the month. The measured insolation in the plane of the collectors averaged 1,656 Btu/ft^2-day, below the expected long-term average of 2,009 Btu/ft^2-day which was derived from measurements taken at the Los Angeles International Airport, California.

C. System Thermal Performance

Collector - Of the 254.16 million Btu of solar energy incident on the collector array during May, 248.49 million Btu were incident on the collector array when there was fluid circulating in the collector loop. The system collected 101.72 million Btu of solar energy, or 40 percent of the total incident insolation on the collector array. In this solar energy system, collected energy is either rejected through the heat rejector or delivered to the load. No storage of energy is provided. During May, 4.36 million Btu of energy were rejected by the heat rejector in the collector-to-load loop, resulting in a net collection of 97.36 million Btu of energy.

Space Heating - The outside ambient temperatures during May were low enough to require some heating of the building during 27 days of the month. The resulting heating load was 29.21 million Btu. The heating subsystem utilized 2.77 million Btu of solar energy, and 28.51 million Btu of auxiliary energy. The resulting solar fraction for space heating is nine percent. The operating energy of the space heating subsystem was 1.85 million Btu.

Space Cooling - The space cooling subsystem was used on all but one day in the month of May. The space cooling load was 111.74 million Btu. There was 80.88 million Btu of solar energy used, and 434.49 million Btu of auxiliary energy used for space cooling. The sum of the solar and auxiliary energies

used was 515.37 million Btu, which supported the space cooling load through the absorption chillers. The resulting solar fraction for space cooling is 19 percent, and the operating energy of the space cooling subsystem during May was 89.45 million Btu.

D. Observations

During May, 21.25 million Btu of auxiliary energy were delivered from the load loop, through the heat exchanger, to the collector loop. This occurred early in the mornings, usually prior to sunrise when the collector pumps were initially turned on, and there was either a heating or cooling load, thus, providing flow through the load-side of the heat exchanger. A calculated value of 3.18 million Btu of energy was collected when no insolation was available. This phenomenon is believed to be caused by the ability of the collector tubes to maintain relatively high fluid temperatures overnight, thereby maintaining a positive temperature change across the collector array; the collector pumps are initially turned on around 6:00 a.m. each day.

The calculated value of energy extracted from the load-side of the collector-to-load heat exchanger was 92.40 million Btu. This value is only five percent less than the net solar energy collected. An energy imbalance is occasionally seen at this point, with slightly more energy measured as being delivered to the load than was collected. This energy imbalance is believed to be due to uncertainties in temperature measurement, and the fact that some of the auxiliary energy delivered to the collectors is returned as useful energy. The average flow rate through the heat exchanger in the collector-to-boiler loop is relatively large at approximately 4,998 lbs/min. Therefore, an energy imbalance can be observed due to a small uncertainty in the temperature measurement T401 and T451.

Irvine School is a large building with few windows. It contains 41,109 square feet of floor area, and is normally occupied by 910 people. Considering the climate of Orange County, buildings of this type generally require heating and

cooling during most months. The heating and cooling system at Irvine School is designed to operate simultaneously when necessary. There are seven separate zones in the building which are heated or cooled. The current instrumentation philosophy does not permit thermal analysis of each zone separately. Therefore, the data in the space heating and space cooling subsections of the attached report refers to the combined cooling or combined heating requirements for the entire school.

Similarly, the inside ambient air temperature defined in the space heating and space cooling subsections of the attached report does not reflect the average temperature for all zones, but represents the average inside ambient air temperature in the area of the sensor.

The month of May was significantly warmer than normal, while the total amount of insolation was well below normal. The combination of these two factors produced a large space cooling load which could not be readily met by the solar system, and hence a low solar fraction for this month.

The average daily values of the Coefficient of Performance (COP) for the absorption chillers range from a low of 0.03 to 0.35. These values may be misleading, indicating erroneously low chiller efficiency, without a brief explanation of chiller operation. The absorption chillers at Irvine School are two very large capacity (100 ton) units. When the chillers are to support relatively small space cooling loads, such as occurred this month, two problems are experienced. First, the generator section of the chiller must be brought up to operating temperature. This could take a couple of hours, during which solar or auxiliary energy is used with little cooling produced. Second, internal design of the chillers causes by-pass valves to be open if condensing water returning from the cooling tower is below approximately 85°F. The result is that little cooling is being accomplished within the chiller; it is primarily being done at the cooling tower. Both of these conditions combine in the mornings and during light cooling loads, to result in a low calculated value of the chiller COP ($\sim$0.1-0.2). When a large load is experienced, the COP rises up to near 0.6, but drops back as the load is

reduced later in the day. The result is then a relatively low average COP value for tne day as shown in the tables. It should be noted that the largest COP of the month occurred on the day with the largest cooling load. This daily value could possibly be increased by internal modification of the chillers, on external bypass connecting the cooling towers to the conditioned space, or by delaying chiller operation until a larger load was to be supported.

An estimated value of 15 KW was used for power consumption of the pumps in the cooling tower loop, since these pumps are uninstrumented.

E. Energy Savings

The Irvine School solar energy system resulted in a fossil fuel savings of 139.41 million Btu at an operating expense of 11.47 million Btu of electrical energy. Converting the electrical energy to a fossil equivalent yields 38.23 million Btu of operating energy. Therefore, the net fossil savings was 101.18 million Btu. The fossil energy savings calculations are based on a comparison of the projected energy requirements of a conventional, fossil energy boiler, with an efficiency of 60 percent, and the energy requirements of the solar energy system.

III. ACTION STATUS

All sensors associated with the absorption chiller operation are being re-calibrated to correct a small energy imbalance observed in its operation.

SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM

MONTHLY REPORT
SITE SUMMARY

SITE: IRVINE SCHOOL IRVINE CALIFORNIA SOLAR/2021-79/05
REPORT PERIOD: MAY,1979

SITE/SYSTEM DESCRIPTION:
THE SOLAR ENERGY SYSTEM WILL AUGMENT THE EXISTING HEATING AND COOLING SYSTEM BY PROVIDING HEATED WATER FOR ABSORPTION CHILLERS AND BUILDING HEAT. SOLAR ENERGY IS COLLECTED BY BANKS OF EVACUATED GLASS TUBE COLLECTORS AND TRANSFERRED TO THE LOADS VIA A HEAT EXCHANGER.

GENERAL SITE DATA:

INCIDENT SOLAR ENERGY	254.163	MILLION BTU
	51346	BTU/SQ.FT.
COLLECTED SOLAR ENERGY	101.720	MILLION BTU
	20550	BTU/SQ.FT.
AVERAGE AMBIENT TEMPERATURE	66	DEGREES F
AVERAGE BUILDING TEMPERATURE	76	DEGREES F
ECSS SOLAR CONVERSION EFFICIENCY	0.33	
ECSS OPERATING ENERGY	11.467	MILLION BTU
TOTAL SYSTEM OPERATING ENERGY	102.769	MILLION BTU
TOTAL ENERGY CONSUMED	805.356	MILLION BTU

SUBSYSTEM SUMMARY:

	HOT WATER	HEATING	COOLING	SYSTEM TOTAL
LOAD	N.A.	29.214	111.736	140.949 MILLION BTU
SOLAR FRACTION	N.A.	9	19	17 PERCENT
SOLAR ENERGY USED	N.A.	2.768	80.878	83.646 MILLION BTU
OPERATING ENERGY	N.A.	1.850	89.451	102.769 MILLION BTU
AUX. THERMAL ENERGY	N.A.	28.506	434.489	475.704 MILLION BTU
AUX. ELECTRIC FUEL	N.A.	N.A.	N.A.	N.A. MILLION BTU
AUX. FOSSIL FUEL	N.A.	38.688	554.119	600.589 MILLION BTU
ELECTRICAL SAVINGS	N.A.	N.A.	0.000	-11.467 MILLION BTU
FOSSIL SAVINGS	N.A.	4.613	134.797	139.409 MILLION BTU

SYSTEM PERFORMANCE FACTOR: 0.149

* DENOTES UNAVAILABLE DATA
@ DENOTES NULL DATA
N.A. DENOTES NOT APPLICABLE DATA

REFERENCE: USER'S GUIDE TO THE MONTHLY PERFORMANCE REPORT OF THE NATIONAL SOLAR DATA PROGRAM,FEBRUARY 28,1978, SOLAR/0004-78/18

SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM

MONTHLY PEPORT
SITE SUMMARY

SITE: IRVINE SCHOOL IRVINE CALIFORNIA
REPORT PERIOD: MAY,1979

SOLAR/2021-79/05

SITE/SYSTEM DESCRIPTION:
THE SOLAR ENERGY SYSTEM WILL AUGMENT THE EXISTING HEATING AND COOLING SYSTEM BY PROVIDING HEATED WATER FOR ABSORPTION CHILLERS AND BUILDING HEAT. SOLAR ENERGY IS COLLECTED BY BANKS OF EVACUATED GLASS TUBE COLLECTORS AND TRANSFERRED TO THE LOADS VIA A HEAT EXCHANGER.

GENERAL SITE DATA:

INCIDENT SOLAR ENERGY	268.142 GIGA JOULES
	583087 KJ/SQ.M.
COLLECTED SOLAR ENERGY	107.315 GIGA JOULES
	233360 KJ/SQ.M.
AVERAGE AMBIENT TEMPERATURE	19 DEGREES C
AVERAGE BUILDING TEMPERATURE	25 DEGREES C
ECSS SOLAR CONVERSION EFFICIENCY	0.33
ECSS OPERATING ENERGY	12.098 GIGA JOULES
TOTAL SYSTEM OPERATING ENERGY	108.421 GIGA JOULES
TOTAL ENERGY CONSUMED	849.650 GIGA JOULES

SUBSYSTEM SUMMARY:

	HOT WATER	HEATING	COOLING	SYSTEM TOTAL
LOAD	N.A.	30.820	117.881	148.702 GIGA JOULES
SOLAR FRACTION	N.A.	9	19	17 PERCENT
SOLAR ENERGY USED	N.A.	2.920	85.326	88.246 GIGA JOULES
OPERATING ENERGY	N.A.	1.952	94.371	108.421 GIGA JOULES
AUX. THERMAL ENG	N.A.	30.074	458.385	501.867 GIGA JOULES
AUX. ELECTRIC FUEL	N.A.	N.A.	N.A.	N.A. GIGA JOULES
AUX. FOSSIL FUEL	N.A.	40.816	584.595	633.621 GIGA JOULES
ELECTRICAL SAVINGS	N.A.	N.A.	0.000	-12.098 GIGA JOULES
FOSSIL SAVINGS	N.A.	4.866	142.210	147.077 GIGA JOULES

SYSTEM PERFORMANCE FACTOR: 0.149

* DENOTES UNAVAILABLE DATA
@ DENOTES NULL DATA
N.A. DENOTES NOT APPLICABLE DATA

REFERENCE: USER'S GUIDE TO THE MONTHLY PERFORMANCE REPORT OF THE NATIONAL SOLAR DATA PROGRAM,FEBRUARY 28,1978, SOLAR/0004-78/18

SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM

MONTHLY REPORT
ENERGY COLLECTION AND STORAGE SUBSYSTEM (ECSS)

SITE: IRVINE SCHOOL IRVINE CALIFORNIA
REPORT PERIOD: MAY,1979

SOLAR/2021-79/05

DAY OF MONTH	INCIDENT SOLAR ENERGY MILLION BTU	AMBIENT TEMP DEG-F	ENERGY TO LOADS MILLION BTU	AUX THERMAL TO ECSS MILLION BTU	ECSS OPERATING ENERGY MILLION BTU	ECSS ENERGY REJECTED MILLION BTU	ECSS SOLAR CONVERSION EFFICIENCY
1	7.577	63	3.086	0.661	0.379	0.000	0.366
2	8.856	63	3.845	0.629	0.380	0.000	0.396
3	8.319	64	3.543	0.685	0.375	0.000	0.382
4	9.210	65	3.744	0.655	0.332	0.000	0.382
5	7.244	64	0.000	0.000	0.313	0.724	0.000
6	5.532	62	2.083	0.988	0.378	0.000	0.328
7	6.941	61	2.408	0.460	0.335	0.000	0.319
8	10.494	61	4.361	0.553	0.335	0.000	0.396
9	11.870	62	4.930	0.258	0.341	0.000	0.393
10	11.818	66	4.988	0.318	0.340	0.000	0.402
11	11.584	72	5.070	0.415	0.342	0.000	0.402
12	11.871	78	0.000	0.000	0.298	1.826	0.000
13	12.051	82	5.711	0.774	0.412	0.000	0.443
14	11.843	71	5.795	0.798	0.402	0.000	0.439
15	11.184	66	4.985	1.033	0.393	0.000	0.412
16	6.087	64	2.713	1.195	0.385	0.000	0.357
17	8.704	64	2.728	0.821	0.362	0.000	0.301
18	9.392	65	2.907	0.518	0.331	0.000	0.296
19	5.507	63	1.709	1.085	0.312	0.000	0.257
20	2.789	64	1.042	1.395	0.395	0.000	0.269
21	5.789	67	2.451	1.101	0.394	0.000	0.365
22	11.091	69	5.108	0.329	0.347	0.000	0.420
23	10.719	70	4.817	1.114	0.386	0.000	0.422
24	6.494	67	3.030	1.441	0.422	0.000	0.384
25	9.412	68	3.859	1.075	0.403	0.000	0.370
26	8.745	68	0.000	0.000	0.423	1.814	0.000
27	1.766	64	0.000	0.000	0.427	0.000	0.000
28	3.234	66	0.076	0.000	0.338	0.000	0.000
29	4.930	65	1.947	0.664	0.383	0.000	0.274
30	7.902	66	3.395	0.838	0.380	0.000	0.390
31	5.210	67	2.066	1.449	0.422	0.000	0.353
SUM	254.163	-	92.398	21.253	11.467	4.364	-
AVG	8.199	66	2.981	0.686	0.370	0.141	0.329
NBS ID	Q001	N113			Q102		N111

* DENOTES UNAVAILABLE DATA.
@ DENOTES NULL DATA.
N.A. DENOTES NOT APPLICABLE DATA.

SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM

MONTHLY REPORT
COLLECTOR ARRAY PERFORMANCE

SITE: IRVINE SCHOOL IRVINE CALIFORNIA SOLAR/2021-79/05
REPORT PERIOD: MAY,1979

DAY OF MONTH	INCIDENT SOLAR ENERGY MILLION BTU	OPERATIONAL INCIDENT ENERGY MILLION BTU	COLLECTED SOLAR ENERGY MILLION BTU	DAYTIME AMBIENT TEMP DEG F	COLLECTOR ARRAY EFFICIENCY
1	7.577	7.513	2.909	72	0.384
2	8.856	8.785	3.784	72	0.427
3	8.319	8.290	3.455	73	0.415
4	9.210	9.195	3.837	75	0.417
5	7.244	6.937	1.784	71	0.246
6	5.532	5.496	2.003	68	0.362
7	6.941	6.762	2.434	68	0.351
8	10.494	10.358	4.267	69	0.407
9	11.870	11.644	4.912	74	0.414
10	11.818	11.619	4.938	77	0.418
11	11.584	11.374	4.892	89	0.422
12	11.871	9.642	3.588	99	0.302
13	12.051	12.051	5.845	102	0.485
14	11.843	11.843	5.275	87	0.445
15	11.184	11.184	5.063	77	0.453
16	6.087	6.087	2.305	70	0.379
17	8.704	8.704	4.084	73	0.469
18	9.392	9.079	3.920	76	0.417
19	5.507	4.839	1.849	72	0.336
20	2.789	2.789	0.932	69	0.334
21	5.789	5.789	2.379	74	0.411
22	11.091	10.894	4.748	82	0.428
23	10.719	10.719	4.707	82	0.439
24	6.494	6.494	2.685	73	0.413
25	9.412	9.308	4.057	77	0.431
26	8.745	8.745	2.597	77	0.297
27	1.766	1.766	0.938	67	0.531
28	3.234	2.735	0.759	71	0.235
29	4.930	4.796	1.537	72	0.312
30	7.902	7.836	3.230	74	0.409
31	5.210	5.210	2.003	73	0.384
SUM	254.163	248.485	101.720	-	-
AVG	8.199	8.016	3.281	76	0.400
NBSID	Q001		Q100		N100

* DENOTES UNAVAILABLE DATA.
@ DENOTES NULL DATA.
N.A. DENOTES NOT APPLICABLE DATA.

SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM

MONTHLY REPORT
SPACE HEATING SUBSYSTEM

SITE: IRVINE SCHOOL IRVINE CALIFORNIA
REPORT PERIOD: MAY,1979

SOLAR/2021-79/05

DAY OF MON.	SPACE HEATING LOAD MILLION BTU	SOLAR FR.OF LOAD PCT	SOLAR ENERGY USED MILLION BTU	OPER ENERGY MILLION BTU	AUX THERMAL USED MILLION BTU	AUX ELECT FUEL MILLION BTU	AUX FOSSIL FUEL MILLION BTU	ELECT ENERGY SAVINGS MILLION BTU	FOSSIL ENERGY SAVINGS MILLION BTU	BLDG TEMP DEG. F	AMB TEMP DEG. F
1	1.148	7	0.078	0.062	1.185	N	1.657	N	0.130	76	63
2	1.080	10	0.112	0.056	1.029	O	1.251	O	0.187	76	63
3	1.231	9	0.109	0.063	1.222	T	1.653	T	0.181	76	64
4	1.001	9	0.091	0.054	0.966		1.340		0.151	76	65
5	0.000	0	0.000	0.000	0.000	A	0.000	A	0.000	76	64
6	1.581	5	0.080	0.082	1.526	P	1.789	P	0.134	74	62
7	1.896	7	0.138	0.094	1.906	P	2.197	P	0.231	74	61
8	1.396	10	0.139	0.071	1.389	L	1.260	L	0.232	75	61
9	1.705	13	0.226	0.085	1.473	I	1.432	I	0.376	75	62
10	1.500	13	0.192	0.077	1.344	C	1.316	C	0.321	75	66
11	0.863	10	0.082	0.042	0.854	A	1.028	A	0.137	77	72
12	0.000	0	0.000	0.000	0.000	B	0.000	B	0.000	78	78
13	0.699	15	0.104	0.038	0.574	L	0.840	L	0.173	79	82
14	0.421	22	0.094	0.024	0.338	E	0.589	E	0.156	78	71
15	0.844	18	0.150	0.042	0.701		0.964		0.250	78	66
16	1.165	9	0.104	0.057	1.052		1.417		0.173	77	64
17	1.353	10	0.132	0.067	1.235		1.700		0.220	76	64
18	1.518	11	0.161	0.074	1.438		1.905		0.269	77	65
19	0.865	3	0.030	0.222	1.271		2.252		0.050	76	63
20	1.571	4	0.060	0.082	1.509		2.154		0.100	75	64
21	0.953	7	0.065	0.056	0.905		1.448		0.109	76	67
22	0.906	12	0.113	0.056	0.953		1.318		0.188	77	69
23	0.684	15	0.100	0.049	0.641		1.052		0.167	78	70
24	0.698	8	0.058	0.079	0.763		1.885		0.096	78	67
25	0.634	16	0.143	0.129	0.690		1.274		0.238	78	68
26	0.000	0	0.000	0.000	0.000		0.000		0.000	78	68
27	0.000	0	0.000	0.000	0.000		0.000		0.000	75	64
28	0.350	0	0.000	0.022	0.435		0.600		0.000	74	66
29	1.003	4	0.041	0.053	1.009		1.443		0.068	75	65
30	1.191	8	0.090	0.065	1.179		1.641		0.149	76	66
31	0.957	7	0.074	0.053	0.922		1.283		0.124	77	67
SUM	29.214	-	2.768	1.850	28.506	N.A.	38.688	N.A.	4.613	-	-
AVG	0.942	9	0.089	0.060	0.920	N.A.	1.248	N.A.	0.149	76	66
NBS	Q402	N400	Q400	Q403	Q401		Q410	Q415	Q417	N406	N113

* DENOTES UNAVAILABLE DATA.
@ DENOTES NULL DATA.
N.A. DENOTES NOT APPLICABLE DATA.

SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM

MONTHLY REPORT
SPACE COOLING SUBSYSTEM

SITE: IRVINE SCHOOL IRVINE CALIFORNIA
REPORT PERIOD: MAY, 1979

SOLAR/2021-79/05

DAY OF MON.	SPACE COOLING LOAD MILLION BTU	SOLAR FR. OF LOAD PCT	SOLAR ENERGY USED MILLION BTU	OPER ENERGY MILLION BTU	AUX THERMAL USED MILLION BTU	AUX ELECT FUEL MILLION BTU	AUX FOSSIL FUEL MILLION BTU	ELECT ENERGY SAVINGS MILLION BTU	FOSSIL ENERGY SAVINGS MILLION BTU	BLDG DRY BULB TEMP F	AMB TEMP DEG F
1	3.900	15	2.694	3.210	17.491	N	23.356	0.000	4.490	76	63
2	3.918	17	3.392	3.252	17.403	O	17.544	0.000	5.653	76	63
3	4.304	17	3.070	3.251	17.611	T	23.238	0.000	5.117	76	64
4	4.062	21	3.424	3.196	15.209		19.037	0.000	5.707	76	65
5	0.005	0	0.000	1.234	0.000	A	0.000	0.000	0.000	76	64
6	1.370	5	1.736	3.175	17.477	P	20.390	0.000	2.893	74	62
7	3.094	12	2.076	3.044	17.637	P	19.351	0.000	3.459	74	61
8	3.254	22	4.013	3.015	16.419	L	16.688	0.000	6.688	75	61
9	3.922	25	4.434	3.138	15.188	I	16.463	0.000	7.391	75	62
10	4.595	26	4.562	3.247	14.825	C	16.465	0.000	7.603	75	66
11	5.774	27	4.578	3.313	14.510	A	17.451	0.000	7.629	77	72
12	0.271	0	0.000	1.245	0.000	B	0.000	0.000	0.000	78	78
13	4.370	30	5.236	3.673	13.932	L	18.048	0.000	8.727	79	82
14	6.772	27	5.104	3.658	14.549	E	19.266	0.000	8.507	78	71
15	5.425	24	4.453	3.383	15.446		20.265	0.000	7.421	78	66
16	4.366	11	2.071	3.211	17.572		23.310	0.000	3.452	77	64
17	4.335	14	2.486	3.217	16.739		22.532	0.000	4.143	76	64
18	4.797	14	2.619	3.272	17.137		22.513	0.000	4.365	77	65
19	0.540	9	1.385	3.046	17.081		23.666	0.000	2.309	76	63
20	1.843	4	0.689	3.216	19.220		26.610	0.000	1.148	75	64
21	4.745	11	2.049	3.417	18.830		25.204	0.000	3.415	76	67
22	6.034	24	4.547	3.604	16.399		21.350	0.000	7.578	77	69
23	6.550	23	4.423	3.800	16.423		23.043	0.000	7.372	78	70
24	4.860	18	2.435	2.901	14.728		20.457	0.000	4.058	78	67
25	4.735	23	3.335	2.718	13.276		18.180	0.000	5.559	78	68
26	0.000	0	0.000	1.235	0.000		0.000	0.000	0.000	78	68
27	0.054	0	0.000	1.234	0.000		0.000	0.000	0.000	75	64
28	0.413	0	0.000	1.430	3.087		4.131	0.000	0.000	74	66
29	3.899	6	1.311	2.617	20.796		27.499	0.000	2.185	75	65
30	4.953	17	2.990	2.773	17.272		23.404	0.000	4.984	76	66
31	4.577	10	1.767	2.729	18.232		24.658	0.000	2.945	77	67

SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM

MONTHLY REPORT
ENVIRONMENTAL SUMMARY

SITE: IRVINE SCHOOL IRVINE CALIFORNIA
REPORT PERIOD: MAY,1979

SOLAR/2021-79/05

DAY OF MONTH	TOTAL INSOLATION BTU/SQ.FT	DIFFUSE INSOLATION BTU/SQ.FT	AMBIENT TEMPERATURE DEG F	DAYTIME AMBIENT TEMP DEG F	RELATIVE HUMIDITY PERCENT	WIND DIRECTION DEGREES	WIND SPEED M.P.H.
1	1531	796	63	72	N	N	N
2	1789	902	63	72	O	O	O
3	1681	688	64	73	T	T	T
4	1861	774	65	75			
5	1463	907	64	71	A	A	A
6	1118	652	62	68	P	P	P
7	1402	862	61	68	P	P	P
8	2120	486	61	69	L	L	L
9	2398	347	62	74	I	I	I
10	2388	343	66	77	C	C	C
11	2340	351	72	89	A	A	A
12	2398	376	78	99	B	B	B
13	2435	362	82	102	L	L	L
14	2392	384	71	87	E	E	E
15	2259	522	66	77			
16	1230	781	64	70			
17	1758	632	64	73			
18	1897	933	65	76			
19	1113	753	63	72			
20	563	480	64	69			
21	1169	787	67	74			
22	2241	618	69	82			
23	2166	613	70	82			
24	1312	535	67	73			
25	1901	628	68	77			
26	1767	792	68	77			
27	357	311	64	67			
28	653	569	66	71			
29	996	870	65	72			
30	1596	769	66	74			
31	1053	838	67	73			
SUM	51346	19663	-	-	-	-	-
AVG	1656	634	66	76	N.A.	N.A.	N.A.
NBS ID	Q001		N113			N115	N114

*-DENOTES UNAVAILABLE DATA.
@ DENOTES NULL DATA.
N.A. DENOTES NOT APPLICABLE DATA.

SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM

MONTHLY REPORT
THERMODYNAMIC CONVERSION EQUIPMENT

SITE: IRVINE SCHOOL IRVINE CALIFORNIA SOLAR/2021-79/05
REPORT PERIOD: MAY, 1979

DAY OF MONTH	EQUIPMENT LOAD MILLION BTU	THERMAL ENERGY INPUT MILLION BTU	OPERATING ENERGY MILLION BTU	ENERGY REJECTED MILLION BTU	COEFFICIENT OF PERFORMANCE (SEE NOTE)
1	3.900	19.583	2.270	21.480	0.199
2	3.918	20.515	2.291	23.317	0.191
3	4.304	20.222	2.309	24.335	0.213
4	4.062	18.440	2.312	23.242	0.220
5	0.005	0.000	1.234	2.585	0.000
6	1.370	19.529	2.221	19.529	0.070
7	3.094	19.483	2.134	22.453	0.159
8	3.254	20.012	2.090	21.799	0.163
9	3.922	19.676	2.203	22.705	0.199
10	4.595	20.088	2.324	24.379	0.229
11	5.774	18.776	2.413	24.911	0.308
12	0.271	0.000	1.245	13.441	0.000
13	4.370	19.977	2.673	24.626	0.219
14	6.772	19.477	2.677	26.214	0.348
15	5.425	19.960	2.431	25.046	0.272
16	4.366	19.872	2.253	23.617	0.220
17	4.335	19.376	2.299	23.018	0.224
18	4.797	19.543	2.371	23.948	0.245
19	0.540	17.521	1.999	17.153	0.031
20	1.843	20.177	2.187	20.649	0.091
21	4.745	21.124	2.422	25.627	0.225
22	6.034	20.505	2.596	25.692	0.294
23	6.550	21.530	2.740	28.201	0.304
24	4.860	17.232	1.981	21.484	0.282
25	4.735	16.804	1.767	21.858	0.282
26	0.000	0.000	1.235	3.085	0.000
27	0.054	0.000	1.234	0.710	0.000
28	0.413	2.406	1.281	3.775	0.172
29	3.899	21.752	1.609	27.665	0.179
30	4.953	20.042	1.732	27.295	0.247
31	4.577	19.311	1.667	24.820	0.237
SUM	111.736	512.929	64.200	638.654	0.218
AVG	3.604	16.546	2.071	20.602	0.007

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NOTE:

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